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ABSTRACT

School classroom evaluation methods using student achievement results are currently a significant topic of investigation in the educational accountability arena. The objective of this study was to identify effective and ineffective elementary school classrooms based on student and teacher characteristics. In this conceptualization, teacher's effectiveness in reading and mathematics was associated with exceptional measured performance above or below that which would be expected from students across the district. The analyses were conducted on 416 third grade classrooms (year 1) and 391 third grade classrooms (year 2) from 87 elementary schools in the Jefferson County Public Schools in Louisville, Kentucky. In all there were 276 teachers in each year and 6,692 students the first year and 6,522 the second year. The findings of the multiple regressions indicate that previous test score was the strongest predictor of student achievement. Student characteristics and teacher characteristics also significantly contributed to the explained variance of the regression model, yet not at the same magnitude as previous test scores. Future research efforts include the study of best practices of high performing teachers identified by the findings of the residual analysis. (Contains 3 tables and 50 references.) (Author/SLD)

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Classroom Accountability: A Value-Added Methodology

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Abstract

School classroom evaluation methods using student achievement results are currently a significant topic of investigation in the educational accountability arena. The objective of this study was to identify effective and ineffective elementary school classrooms based on student and teacher characteristics. In this conceptualization, teacher's effectiveness in reading and math was associated with exceptional measured performance above or below that would be expected from the students across the district. The findings of the multiple regressions indicate that previous test score was the strongest predictor of student achievement. Student characteristics and teacher characteristics also significantly contributed to the explained variance of the regression model, yet not at the same magnitude as previous test scores. Future research efforts include the study of best practices of high performing teachers identified by the findings of the residual analysis.

Keywords: Classroom Accountability, Value-Added Methodology, Teacher Effectiveness

Classroom Accountability: A Value-Added Methodology

School classroom evaluation methods using student achievement results are currently a significant topic of investigation in the educational accountability arena (Millman, 1997). Historically, effective school research has been a forerunner in taking a value-added approach to school improvement. After identifying low-income, high-performing schools, these studies attempted to identify the characteristics of schools that make them instructional effective for disadvantage students (Brookover, Beady, Flook, Schweitzer, & Wisenbaker, 1979; Clark, Lotto, & McCarthy, 1980; Edmonds, 1979; Purkey & Smith, 1983; Rutter, Maughan, Mortimore, Outson, & Smith, 1979).

The effective school research was typically formulated as a two-stage process. The first stage identified schools that are particularly effective for low socioeconomic status children. In the second stage, researchers searched for characteristics that were common among the school identified as effective. Edmonds (1979) concluded that all schools could be effective should they adhere to the multiple components for success; this author and leader of the effective school research reinforced the idea that leadership, expectations, atmosphere and instructional emphasis are consistently essential institutional determinants of pupil performance.

Since the "effective schools" movement of the late 70's, there has been an emphasis on the importance of teachers and school staff on the improvement in student achievement. The risk, however, has been to ignore the student's background and other contextual factors that also affect student performance (Gibson & Asthana, 1998); this leads to the belief that schools can effect achievement largely independently of contextual constraints. According to the authors, until the contextual factors are better understood, the spiral of disadvantage will continue. In

recent years, there has been an interest in the role that contextual factors have on the quality and performance of schools and their pupils (Stronge & Tucker, 2000; Webster, 1994).

Effective schools are usually distinguished from ineffective schools based on whether students learn what is reportedly being taught. According to Sanders and Horn (1995a), rarely is previous achievement data used in determining whether a student is learning. According to the authors, the main reason is associated with the difficulty in separating school effects on learning from demographic and previous test scores effects. Currently, the media and general public judge school effectiveness, in most cases, on their overall student performance on standardized tests. This is a very simplistic comparison that leads to public labeling and stigmatization of the low-performing schools.

Another line of inquiry that was developed simultaneously with the effective school research was the teacher effectiveness research. Since the 1970s, Jere Brophy and colleagues have conducted seminal work in this area of research. Teacher effectiveness research is associated with studies linking teacher behavior to student outcomes; it is related to studies of teachers in the classroom to discover effective practices (Brophy, 1988). According to this author (1979), for example, direct instruction in small groups coupled with formal organization and management are as effective in producing satisfactory learning results at the secondary level as they are in teaching basic skills at the elementary level. Good and colleagues (1983) found that the amount of learning by pupils is related to exposure to content, teachers maximizing pupil learning allocate more classroom time to academic activities, greater learning is associated with frequent presentation of materials and practice and application of what is learned, and teacher beliefs about students correlates with student achievement.

Value-Added Methodological Approaches to Teacher Effectiveness

Determining effective teaching has been a problem for educational researchers. New approaches have been developed in the last two decades, especially in developments in using student achievement data. The use of student assessment data in the evaluation of teachers has become a major theme in the educational research community (Millman, 1997). Educational outcome indicators are usually used to measure the performance of school, programs, policies, and teachers. Reliance on such indicators is largely the result of the accountability era in education: a growing demand to hold schools accountable for their performance, defined in terms of outcomes, such as standardized test scores in reading, math, social studies and science, rather than inputs, such as teacher qualifications, class size, or the quality of lab facilities (Meyer, 2000).

Meyer (1996, 2000) has studied the difference and significance of value-added indicators of school performance. Multiple weaknesses accompany the most commonly used educational outcome indicators such as the average and median test scores, proficiency level indicators (i.e., measure the proportion of students who score above a specified proficiency level cut point), and gain indicator (i.e., the change in average test scores from grade to grade for the same cohort of students). Overall, these typical performance indicators tend to be biased against schools and programs that disproportionately serve at-risk students with high mobility. In this instance, the main source of bias is the well-known fact that school productivity is only one of the many determinants of student achievement. In fact, the differences in prior achievement, student and family characteristics (control variables) account for far more of the variation in student achievement than school-related factors (Meyers, 2000; Munoz & Dossett, 2001). A value-added

methodology is one that statistically adjusts the outcome variables by the important inputs that relate to these outcomes, but that are not under the control of schools.

> The essence of the value-added approach is that school and program performance is measured using a statistical regression model that includes, to the extent possible, all of the nonschool factors that contribute to growth in student achievement, in particular, prior student achievement and student, family, and neighborhood characteristics. The key idea is to statistically isolate the contribution of schools and programs to *growth in student achievement* at a given grade level from all other sources of student achievement growth. (Meyers, 2000, p. 2)

In general, according to Meyers (2000), the quality of a value-added indicator is determined by four factors: (a) the frequency with which students are tested, (b) the quality and appropriateness of the tests that underlie the indicators, (c) the adequacy of the control variables included in the value-added models, and (d) the appropriateness (validity) of the statistical model used to define the indicator. Ongoing research is needed to assess the sensitivity of estimates of school performance to alternative statistical models and alternative sets of control variables.

Prime examples in this arena of value-added research systems are (a) the Oregon teacher work sample methodology (Airasian, 1997); (b) the Minneapolis value-added system (Du & Heistad, 1999); the Dallas value-added accountability system (Webster & Mendro, 1997); and, (d) the Tennessee Value-Added Assessment System (Sanders & Horn, 1994, 1998). Teacher evaluation and student achievement are becoming two intertwined concepts. In the next section a brief overview of the aforementioned systems will be presented.

Oregon Teacher Work Sample Methodology

The Oregon Teacher Work Sample Methodology (TWSM) is a method intended to link student learning gains to teacher performance (Airasian, 1997). The eight steps methodology is structured and leads the teachers to think through and link objectives, teaching methods, resources, pupil needs, and pupil assessment in a logical manner. It is designed to foster both formative and summative teacher self-evaluation. The main characteristic is that it focuses teachers on pupil learning as the fundamental purpose of good teaching. The Index of Pupil Growth (IPG) is used to determine the percentage of potential growth evidenced by pupils from pre- to post-testing.

The IPG is essentially a gain score metric. Although initial work has been started, it is clear that raw gain scores do not provide a direct indication of the unique contribution a teacher makes to the gains. Other factors such as pupils' prior knowledge, socioeconomic status, student language proficiency, classroom resources and the like also can influence student learning gains. To determine the aforementioned elements, it requires the extraction from gain scores of factors that relate to pupil learning, but mask a teacher's unique contribution.

From a measurement perspective, face and content validity do not appear to be a problem. According to Airasian (1997), however, there are a number of concerns associated with the tests and scales used in TWSM. For example, the quality of the pre- and posttests constructed by teachers to assess their pupils learning. Concerns include the quality of the test items, the levels of pupil learning being assessed, the variability in difficulty across tests, the number of items per test, the format of the items, and the comparability of the pre- and posttests. Nor it is clear to what extent teachers select easy-to-meet objectives or teach narrowly to the specific posttest items.

Minneapolis Public School

Minneapolis Public School (MPS) uses the value-added approach to identify effective teachers to replicate their success, rather than to identify teachers that are categorized as ineffective. MPS rates schools, students, and teachers along a performance continuum by using a statistical model that incorporates core indicators such as (a) student achievement gain compared to expected gain, (b) narrowing of gaps in achievement between different groups of students in state defined standards, (c) learning climate, (d) safety, (e) student satisfaction and involvement, and, (f) family satisfaction and involvement (Du & Heistad, 1999). The district uses these results to provide schools feedback, which can range from monetary bonuses to intensive support, including the reconstitution of the school staff.

The school performance data is determined from student achievement, attendance and suspensions data as well as teacher, student, and parent surveys. MPS use the value-added statistical methodology to determine both school and teacher effectiveness. In order to estimate the value-added effects of the schools and teachers, the MPS use two statistical models. First, an ANCOVA model is used to control for differences in student characteristics and initial achievement level. Second, a two-stage hierarchical linear model is used for controlling school level variables (Du & Heistad, 1999).

The MPS model shows that, at the student level, (a) prior reading score, (b) socio-economic status (as measured by free and reduced lunch eligibility), (c) gender, (d) limited English proficiency, (e) special education background, and (f) minority background significantly affected student achievement (Du & Heistad, 1999). More than two thirds of the variance is explained by the background factors. A value-added index is calculated for all schools. Schools performing better than one standard deviation are considered effective, while schools performing

below one standard deviation are considered ineffective. The same models were applied to determine teacher effectiveness.

> Using the value-added approach and controlling for student characteristics such as poverty, gender, race, special learning needs and prior achievement, we can distinguish teacher's instructional effects and school effectiveness from external factors outside the influence of the teacher and the school (Du & Heistad, 1999, p. 20).

The Dallas Value-Added Accountability System

In response to racial court litigations and requirements, the Dallas Independent School District (DISD) developed a model for accountability. The use of assessment data was viewed as the most effective piece in developing such a model. Commitment to participate from all stakeholders was also strongly emphasized in the model. The model integrated state accountability requirements within everyday assessment efforts at the local jurisdiction (school district) and, at the same time, incorporated managerial responses to effectiveness and ineffectiveness data at the teacher and school level (Cunningham, 1997). The school effectiveness methodology, as implemented in the DISD, defines a school's effectiveness as being associated with exceptional measured performance above or below that which would be expected across the entire District. That is the case when a school population of students departs markedly from its own pre-established trend.

For several years during the mid1980s, DISD used a multiple regression to rank schools for effectiveness. This method was used to determine if schools exceeded their predicted growth (Webster & Mendro, 1997). In the early 1990s, the DISD Board of Education established a Commission for Educational Excellence, which recommended the development of an accountability system that was based on variables in addition to test scores (Webster & Mendro,

1997). The task force, composed of teachers, principals, parents, members of the business community, and central office administrators, required that the new methodology would meet the following criteria: (a) it must be value-added; (b) it must include multiple outcome variables; (c) schools must only be held accountable for students who have been continuously enrolled and exposed to their instructional program; (d) it must be based on cohorts of students, not on cross-sectional data; and, (e) it must be fair. In terms of fairness, schools must derive no particular advantage by starting with high scoring, non-minority, high socioeconomic status, or non-limited English proficient students. This system is believed to be fair and equitable. In addition, factors over which the schools have no control, like student mobility, must be taken into consideration (Webster, Mendro, & Almaguer, 1994; Webster, Mendro, Orsak, & Weerasinghe, 1998).

During last decade, DISD has used a value-added accountability system to determine effective schools. This system has recently been expanded to assist in identifying effective teachers and to shape teacher evaluations for the district. The new and current system combines using multiple regression and hierarchical linear modeling. In the first stage, a multiple regression model is used regressing outcome and predictor variables against covariates called "fairness variables". Student test scores are regressed against nine student level characteristics or covariates; ethnicity, limited English proficiency status, gender, and socioeconomic variables. In the second stage, the methodology developed produces school effectiveness estimates is a two-level student-school or student-teacher HLM model that uses the residuals resulting from the multiple regression (Webster & Mendro, 1997; Webster, Mendro, Orsak, & Weerasinghe, 1998; Weerasinghe, Anderson, & Bembry, 2001). The school level outcome is called the "School Effectiveness Indices" (SEI) and the teacher level outcome is called the "Classroom Effectiveness Indices" (CEI).

According to Webster and Mendro (1997), the Dallas accountability model, does the following: (a) controls for "fairness variables" or preexisting student differences in ethnicity, gender, language proficiency, and socioeconomic status; (b) includes a criterion- and norm-referenced test scores, student attendance rates, dropout rates, student retention rates, student enrollment in honors courses and advanced diploma plans, graduation rates, and percentage of students taking college entrance tests; (c) weights test scores more heavily than other variables based on the determination by the Accountability Task Force; (d) includes holding schools accountable for only those students that have been there long enough for the school to have impacted their education; and, (e) includes testing at least 95% of the eligible students so that schools would not withhold students from testing.

Tennessee Value-Added Assessment System

The Tennessee Value-Added Assessment System (TVAAS) is a numerical, multi-level model developed with the intention to give unbiased estimates of the effect of school systems, schools, and teachers on the academic gains of students (Bratton, Horn, & Wright, 2001; Sanders, Saxton, Schneider, Dearden, Wright, & Horn, 1994). This model relies on the scaled scores derived from the norm-referenced part of the Tennessee Comprehensive Assessment Program (TCAP) test, which is taken by all students in Tennessee from grades 2 through 8.

In the TVAAS multi-level model, the students are serving as their own control for extraneous factors, such as socio-economic status and student body composition (Sanders & Horn, 1995b). The goal is not to compare students, but to measure the progress each student makes in a school year. The assessment system determines an effective school as a school that provides educational opportunities for all students regardless as to whether the student is an advanced or slower learner. The authors argue that the TVAAS was developed on the premise

that society has a right to expect that schools will provide students with the opportunity for academic growth regardless of the level at which the students enter the educational venue. In other words, all students can and should learn commensurate with their abilities.

Sanders and Rivers (1996) completed a TVAAS study with two large school systems on the cumulative effects of teachers on student achievement using three years of data. First, they developed an estimate of teacher effect on a current test scores controlling for previous achievement. According to their research, an effective teacher can facilitate excellent academic gains after a relatively ineffective teacher, but the residual of effects of the ineffective teacher can be measured in subsequent student achievement scores. Findings indicated that the two lower quintiles did not facilitate gains for most of their students. In addition, ethnic group differences were observed within each quintile. The findings showed similar gains across ethnic groups within each teacher quintile, but that assignment to the lower quintile was slightly disproportionate with more black students.

More recently, Sanders and Rivers (2001) completed an evaluation of a group of elementary schools located in the 29th largest school system in the nation. Three CTBS scale test scores (i.e., reading, language arts, and mathematics) were used as predictors. The number of cases required per classroom was ten students. The decision criterion for identifying above, on average, or below teachers was to double the standard error on a variable called teacher effect. Of the fifty-nine classrooms in the study, the TVAAS methodology identified eight classrooms as effective, eight classrooms as ineffective, and forty-three classrooms as average.

Comparison of Methodologies

Studies have been conducted to compare the different methodological approaches. A study on teacher effectiveness compared the TVAAS mixed-effect model with the traditional

OLS multiple regression method (Rodosky & Munoz, 2002). The regression approach was derived from work previously done by Stronge and Tucker (2000). In the regression, analysis of standard errors or residuals helped to identify below average, on average, and above average teachers. In the TVAAS, a teacher effect variable and standard errors were calculated; the teacher effect variable had to be at least two times the standard error to be considered. In terms of explanatory power, both methods had approximately 50 percent of explained variance. In looking at the effective teachers, both methods identified the same number of effective classrooms. Although an adjusted cut score facilitated a better level of agreement between both methodologies, discrepancies were observed when identifying ineffective classrooms.

Multilevel analysis is just one of many methods for understanding data and it may not always work. Kreft and De Leeuw (1998) argued that multilevel models are useful if the data is constructed similarly to the multilevel model, if previous research exists that guides the explanatory variables and random components, and the user had knowledge of the data. Arnold (1992) also lists several limitations to using hierarchical models when measuring teacher effectiveness, including that (a) no single methodology should be used when evaluating teacher effectiveness, (b) classrooms with few students have low reliability, (c) may not measure effective classrooms which are not directly tested on standardized test, (d) limited when measuring students that have multiple teachers, (e) limited when measuring students that are highly mobile, and, (f) does not take into account the effect certain combinations of teachers may have over time. Multi-level models are similar to regression models in that they do not show causality, but only how variables can predict other variables.

Variables Associated With School and Teacher Effectiveness

A set of variables that have shown to be important in previous research on school performance is prior academic achievement (Chubb & Moe, 1990; Smith & Meier, 1995). In many studies of students and schools, performance on achievement tests is highly correlated with previous levels of academic achievement. At the district level, for example, Smith and Meier (1995) found that school systems doing well in the past continue to perform well. The study supported the hypothesis that previous academic performance is a strong predictor of future performance. At the individual student level, Chubb and Moe (1990) used initial student scores on tests as a predictor of achievement gain scores. In this particular study, sophomore scores were subtracted from senior scores in their regression models. The researchers found that student ability or initial achievement was the strongest determinant of achievement gains.

Another set of variables known to be important for determining academic performance is family background of students (Roeder, 1999; Munoz & Dossett, 2001). Roeder (1999, 2000) studied the performance of schools in relationship to selected academic and social variables. After controlling for several school and district factors, the researcher concluded that poverty was the strongest determinant of school performance. Similarly, Munoz and Dossett (2001) found that socioeconomic status, operationalized as students participation on the national lunch program, accounted for the highest percent of explained variance in student achievement across four years. Participation in free/reduced lunch explained an average of 58% of the variance across all four regression models.

A final set of factors are teacher-related variables. Although common sense and schooling experiences suggest that teachers and teaching make a difference for student achievement (both positively and negatively), the available empirical evidence shows mixed

findings. Research assessing the performance of school districts in Texas found that characteristics of schooling make a difference; in particular, most of these schooling effects were due to teacher quality (Ferguson, 1991). The researcher found that the primary schooling effect was attributed to teacher performance on a standardized exam, but he also found that two additional measures of teacher quality - years of experience and attainment of a masters' degree also contributed to this schooling effect. In contrast, Lee and Fitzgerald (1996) in their multivariate model of school district performance in Tennessee found that teacher quality (measured by the proportion of professional staff meeting standards) had no significant impact on district performance.

In summary, past research offers ample evidence regarding the role that both teachers and students play in accounting for growth in student achievement. Still, the majority of studies have focused on traditional input variables for both groups. For teachers, this typically translated into years of experience, certification area, education level, while for students, demographic characteristics such as socioeconomic status have taken a prominent position. However, more recently, value-added methodology has been employed a means by which school and district administrators can identify effective classrooms by aggregating pupil gains regardless of differences among entering students (Millman, 1997; Stronge & Tucker, 2000). Similarly, by aggregating scores by teacher, this methodology can be used to identify which students are learning the most and least within each classroom.

Staffing all classrooms with highly qualified teachers, therefore, is a critical national concern. Raising teacher quality has become education reform's top priority. Research affirms that teaching quality is the single most important factor influencing student achievement, moving students well beyond family backgrounds' limitations (Darling-Hammond, 2000; Kaplan &

Owings, 2001; Whitehurst, 2002). The schools students attend and what their teachers know and do is a more important influence on student achievement than students' family characteristics and ethnicity (Darling-Hammond, 2000; Haycock, 1998; Kaplan & Owings, 2001; Whitehurst, 2002). Elementary school students who worked with effective teachers for 3 consecutive years scored higher than peers of the same starting ability taught by ineffective teachers for 3 consecutive years by more than 50 points on standardized tests of mathematics skills (Sanders & Rivers, 1996) and 35 points in reading (Jordan, Mendro, & Weerasinghe, 1997). Working over consecutive years with highly effective teachers produced dramatic gains in student achievement for all student groups--low, middle, and high achieving (Haycock, 1998).

The present study contributes to the existent research examining teacher effectiveness using a longitudinal approach. More specifically, the purpose of this study was to explore teacher effectiveness in reading and math over a two-year period. Because the state assessment system for the school district does not assess the same students in the same content areas for consecutive years, it is imperative that a longitudinal approach be taken in determining teacher effectiveness. The impetus for this research project was a prior effort that identified successful and unsuccessful schools in the school district based on student characteristics. The goal of the present study was to explore further than the school level by identifying effective and ineffective classrooms. The research questions were (1) what is the impact of student and teacher characteristics on third grade teacher effectiveness in reading?; and (2) what is the impact of student and teacher characteristics on third grade teacher effectiveness in mathematics?

In this study, it is expected that classrooms with higher levels of prior academic achievement will perform at higher levels on subsequent academic tests. As result, it is hypothesized that previous test scores will contribute the highest percent of explained variance

on the criterion variable. It is also hypothesized that classrooms with higher proportions of poor children will have lower performance scores. Finally, following Ferguson (1991), it is hypothesized that classrooms with higher proportions of experienced teachers (measured in years) and attainment of a masters' degree certification will perform at higher levels.

Method

Participants

The analyses were conducted on 416 third grade classrooms (year 1) and 391 third grade classrooms (year 2) from 87 elementary schools of Jefferson County Public Schools in Louisville, Kentucky. The classrooms consisted of 6592 students (year 1) and 6522 students (year 2). There were 276 teachers that were included in both year 1 and year 2 samples. Table 1 displays the student and teacher characteristics of these participants.

Table 1

Student and Teacher Characteristics for Year 1 and Year 2

	Year 1		Year 2	
	M	SD	M	SD
Student Characteristics				
Reading Pretest (SDRT)	43.93	20.13	44.43	19.89
Reading Postest (CTBS)	51.22	20.85	51.94	21.04
Math Pretest (SDMT)	42.94	20.64	42.79	20.91
Math Posttest (CTBS)	51.94	20.48	52.47	20.53
Female	.49	.50	.48	.50
African American	.36	.48	.41	.49
Free/Reduced Lunch	.55	.50	.57	.50
Single Parent Household	.51	.50	.56	.50
Teacher Characteristics				
Years Experience	11.15	9.16	10.83	8.88
Masters Degree	.72	.45	.79	.41

The student criteria for inclusion in the present study were (1) not receiving special education services and (2) present 100 days during the 187 day school year. The teacher criteria for inclusion were (1) maintained "active" status during the school year and (2) had eight or more students in their classroom.

Instrumentation

The independent variables included both student characteristics (free/reduced lunch status, race, gender, single parent household, reading and math test scores) and teacher characteristics (education level and years of experience). Free and reduced price lunch status was defined as the percentage of students qualifying for free or reduced lunch according to federal guidelines. Free/Reduced lunch status was dummy coded as 1 = free or reduced price lunch and 0 = paid). Gender was coded as 1 = females and 0 = males. Race was coded as 1 = African American and 0 = other. Single-parent household was the percentage of students whose households are not comprised of both their biological mother and father (coded as 1 = single parent, 0 = other). The test scores were reported in mean Normal Curve Equivalents (NCE) for the Stanford Diagnostic Reading Test (SDRT) and the Stanford Diagnostic Math Test (SDMT). The SDRT reading score represents a composite score of the vocabulary, phonetic analysis, and comprehension subtests. The SDMT math score represents a composite score of the concepts and applications and computation subtests. The diagnostic tests are given to the students at the beginning of the fall semester. The individual student scores were aggregated by classroom membership. The education level of teacher was dummy coded into 1 = Master's Degree or higher and 0 = Bachelor's Degree. The teacher's years of experience represented the number of years that the teacher had been teaching for the school district.

The fundamental dependent variables were the Comprehensive Test of Basic Skills (CTBS/5) Reading and Math test scores. The CTBS is a nationally standardized achievement test administered to students at the end of the spring semester and scores are reported in mean Normal Curve Equivalents (NCE). The individual student scores were aggregated by classroom membership.

Design and Procedures

A hierarchical multiple regression approach was conducted at the student and teacher level, followed by analyses of residuals (Pedhazur, 1982, Pedhazur & Schmelkin, 1992; Stevens, 1997). Multiple regression analyses were performed at the teacher level for both reading and math. The purpose of the residual analyses was to compare expected teacher performance against observed teacher performance. The standardized residuals were calculated for each teacher in the regression analyses. This analysis allowed for the identification of below (-1 standard error), average (-.99 to .99 standard error) and above average (+1 standard error) performance.

The first teacher level regression analysis used the dependent variable: classroom average 3rd grade CTBS Reading NCE scores and the independent variables, classroom average 3rd grade SDRT scores was entered into the first block, classroom percent of Free and Reduced Lunch Status, Single Parent Household, Females, and African Americans were entered into the second block and teacher variables, years of experience and education level were entered into the third block. The second teacher level regression analysis used the dependent variable: classroom average 3rd grade CTBS Math NCE scores and independent variables, classroom average 3rd grade SDMT scores was entered into the first block, classroom percent of Free and Reduced Lunch Status, Single Parent Household, Females, and African Americans were entered into the

second block and teacher variables, years of experience and education level were entered into the third block.

The multiple regression analyses of reading and math scores for the 1999-2000 school year were repeated using the 2000-2001 student and teacher information. Thus a comparison could be made between the two years' results and a judgment regarding the consistency of the findings on effective and ineffective teachers (classrooms) could be established.

Results

The findings show that the multiple regressions had a high percent of explained variance for social science research. Previous test scores appeared as the strongest predictor of student achievement.

Reading Findings (Year 1 and 2)

The percent of explanation of the regression model for Reading – Year 1 was 73.1%. Previous test scores contributed 72.4%, student free/reduced lunch and teacher years of experience added another .01%. No other variable contributed at a significant level. The percent of explanation of the regression model for Reading – Year 2 was 63.1%. Previous test scores contributed 61.5%, student single parent household and teacher education level added another .02%. No other variable contributed at a significant level (see Table 2).

Table 2

Multiple Regression of Student and Teacher Characteristics on Aggregated Student Reading Scores for Year 1 (1999-2000) and Year 2 (2000-2001)

Variables	Year 1			Year 2		
	B	SE B	β	B	SE B	β
Step 1: Student Prior Test Scores						
Pretest (SDRT/SDMT)	.79	.04	.77*	.75	.05	.71*
Step 2: Student Demographics						
Race	.03	.02	.05	.03	.02	.05
Gender	.02	.02	.02	-.04	.03	-.04
Free/Reduced Lunch	-.05	.02	-.12*	-.01	.02	-.02
Single Parent Household	-.02	.02	-.04	-.06	.03	-.12*
Step 3: Teacher Characteristics						
Years Experience	.08	.03	.07*	-.07	.04	-.06
Education Level	-.75	.62	-.03	3.08	.91	.12*

Note. Year 1 Findings, $R^2 = .73$ for Step 1, $\Delta R^2 = .006$, for Step 2, $\Delta R^2 = .004$, for Step 3 (ps < .05). Year 2 Findings, $R^2 = .63$ for Step 1, $\Delta R^2 = .01$, for Step 2, $\Delta R^2 = .01$, for Step 3 (ps < .05).

The analyses of residuals showed the percent of teachers (classrooms) with above average, on average, and below average performance in reading for year 1 and year 2. The percent of teachers with below average reading performance for year 1 was 14.2% (n = 63), average was 70.7% (n = 294), and above average was 15.1% (n = 59). The percent of teachers with below average reading performance for year 2 was 14.2% (n = 59), average was 70.7% (n =

283), and above average was 15.1% (n = 49). The percent of teachers that were included for both year 1 and year 2 analysis of reading was 70.6% (n =276). The percent of teachers that were identified as below average for two consecutive years was 2.5% (n = 7), average was 50.7 (n = 140), and above average was 3.6% (n = 10). The percent of teachers that demonstrated improvement in their classification (i.e. average in year 1 to above average in year 2) was 23.2% (n = 64), while 20% (n = 55) of teachers showed a decline.

Math Findings (Year 1 and 2)

The percent of explanation of the regression model for Math – Year 1 was 67.0%. Previous test scores contributed 65.6% and student free/reduced lunch added 1.5%. No other variable contributed at a significant level. The percent of explanation of the regression model for Math – Year 2 was 63%. Previous test scores contributed 60% and student free/reduced lunch and gender added 3%. No other variable contributed at a significant level (see Table 3).

Table 3

Multiple Regression of Student and Teacher Characteristics on Aggregated Student Math Scores for Year 1 (1999-2000) and Year 2 (2000-2001)

Variables	Year 1			Year 2		
	B	SE B	β	B	SE B	β
Step 1: Student Prior Test Scores						
Pretest (SDRT/SDMT)	.73	.04	.69*	.61	.04	.61*
Step 2: Student Demographics						
Race	-.02	.02	-.03	.02	.02	.03
Gender	.04	.02	.05	.06	.03	.06*
Free/Reduced Lunch	-.06	.02	-.15*	-.07	.02	-.18*
Single Parent Household	-.01	.02	-.02	-.04	.03	-.08
Step 3: Teacher Characteristics						
Years Experience	-.02	.04	-.01	-.03	.04	-.02
Education Level	1.70	.89	.07	.34	.70	.02

Note. Year 1 Findings, $R^2 = .66$ for Step 1, $\Delta R^2 = .02$, for Step 2, $\Delta R^2 = .00$ ($ps < .05$), for Step 3 ($ps > .05$). Year 2 Findings, $R^2 = .63$ for Step 1, $\Delta R^2 = .03$, for Step 2, $\Delta R^2 = .000$ ($ps < .05$), for Step 3 ($ps > .05$).

The analyses of residuals showed the percent of teachers (classrooms) with above average, on average, and below average performance in mathematics for year 1 and year 2.

The percent of teachers with below average math performance for year 1 was 16.5% (n = 66), average was 67.4% (n =269), and above average was 16% (n = 64). The percent of teachers with below average math performance for year 2 was 13.9% (n = 58), average was 72.8% (n = 303), and above average was 13.2% (n = 55). The percent of teachers that were included for both year 1 and year 2 analysis of reading was 70.6% (n = 276). The percent of teachers that were identified as below average for two consecutive years was 2.5% (n = 7), average was 53.6% (n = 148), and above average was 4.3% (n = 12). The percent of teachers that demonstrated improvement in their classification (i.e. average in year 1 to above average in year 2) was 20% (n = 55), while 19.6% (n = 54) of teachers showed a decline.

Comparison of Reading and Math Findings

The findings for year 1 and year 2 regarding teachers' effectiveness in reading and math both revealed that previous test scores were the largest contributor to current test scores. The comparison of those teachers who were identified as below average and those teachers above average in reading for two consecutive years revealed some differences in teacher characteristics. Teachers who were identified as below average had 8.4 mean years of experience, while those above average teachers had 14 mean years of teaching experience. In addition, 71% of the below average teachers had received their Masters Degree while 90% of the above average teachers had attained their Masters Degree.

In contrast, the teacher characteristics were similar between those teachers who were identified as below average and above average teachers in math for two consecutive years. Teachers who were identified as below average had 14.6 mean years of experience and teachers who performed above average had 12.3 mean years of teaching experience. In addition, 85.7% of the below average teachers and 83.3% of above average teachers had received their Masters

Degree. The differences in teacher characteristics for effective (above average) and ineffective (below average) teachers in reading but not in math coincides with the findings that teacher variables contributed to the amount of explained variance in reading yet not in math.

Discussion

The objective of this study was to identify effective and ineffective elementary school classrooms based on student and teacher characteristics by means of using a multiple regression approach followed by an analysis of residuals. The design of this study was based on previous research using value-added approaches to measure teacher effects on student results (Sanders, 2000; Stronge & Tucker, 2000; Webster, 1994). In this conceptualization, an effective teacher is defined as a teacher that causes student improvement on core content educational outcomes such as reading and mathematics. The central objective of identifying effective teachers becomes one of establishing legitimate predictions of student performance and comparing those predictions to actual student outcomes (Webster, 1994). Thus, a teacher's effectiveness is associated with exceptional measured performance above or below that would be expected from the students across the district. Procedures involve using regression analysis, hierarchical linear models, and/or mixed effect models to compute prediction equations by grade level for each outcome variable and then using these equations within classrooms to obtain gains over or below expectations.

This study supported the hypothesis that previous test scores are the best predictor of future academic performance as well as this finding in past research (Chubb & Moe, 1990). The multiple R showed a consistent positive correlation between previous and current reading and math test scores across the two years analyzed. The other student-related socio-demographic variables and teacher-related predictors had a significant contribution to the amount of explained

variance, however those variables together only added less than 1% in reading and 3% in math. In general, the levels of explained variance in the R-squared were high for social science research. A comparison was made between the actual test scores and the predicted test scores such that by examining the standardized residuals of the regression analysis, determinations could be made about classrooms that are average, under- or over-performing based on the selected student and teacher variables. In this particular study, the determination was made using one standardized absolute value residual. The utility of this kind of regression model is that, classrooms are able to compare their predicted unstandardized scores against their actual scores, while considering their particular characteristics in terms of student population and teachers.

Implications for Theory

From a purely theoretical perspective, Murphy (1988) analysis on the relationship between equity and excellence is relevant to this study and other studies approaches to examining school and teacher effectiveness. It is this conceptualization that integrates the principles of equity and excellence as an important issue for the educational reform efforts in an accountability era. The third-generation conceptualization of equity basically comprehends equity as student opportunity to learn, which goes beyond the traditional input and process focus of prior educational reform efforts and establishes an interesting link with the school efforts toward quality expressed in terms of student achievement. Significant policy changes have to be framed by the conceptualization of equity as excellence in the accountability educational reform era. In this regard, this conceptualization of equity is highly inter-related to accountability understood as performance. Under the conceptualization of accountability as performance, output educational indicators are used to track and evaluate not only school achievement, but at another level, teacher effectiveness (Levin, 1974; Wohlstetter, 1991).

Implications for Practice

From a practical perspective, this study supports Murphy and Hallinger (1989) analysis that educational administrators and policy-makers have to refocus the educational reform efforts in general, and the educational equality issues in specific, toward what is going to be taught, to whom, and by whom. Implications for practice include the use of a multiple regression approach (Meyers, 1996; 2000) for identifying teachers with above and below average performance based on student results. Future research efforts include the study of best practices of high performing teachers identified by the findings of the residual analysis. Additional support could be provided to those teachers identified as low performing based on the residual analysis. It might prove promising to apply the methodology to other school levels such as middle and high school; in this context, more teacher variables can be incorporated into the analysis (e.g., teacher certification). Given the nature of this research, more analysis is needed to optimize the methodological approach used in this study.

Limitations of the Study

This study was strictly exploratory and it does not intend to have generalizability. The analysis was restricted to the public elementary schools of a very particular county in the state of Kentucky. This kind of analysis requires careful examination before taking any kind of administrative decisions. Classroom evaluations will always require policy makers to make the best decision based on their particular context. The same applies to the decision on the standardized residual that can be used for defining average, over- and under-performing classrooms. Further research needs to explore other variables that might compose a regression model, similar to the one developed by this school district. Furthermore, other methodological approaches can be used to analyze this kind of research problems.

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